



**Figure 1**

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**(54) Tricycle with a rocking mechanism**

(57) SOLVING MEANS: Left and right suspension arms (71 and 72) are connected by a shock absorber 76 and arcuate links (88 and 89) and bell cranks (90 and 91) provided at the opposite ends of the shock absorber (76).

**EFFECT:** In response to upward and downward movement of the left and right suspension arms (71, 72),

the single shock absorber (76) can be expanded and contracted to effect damping action of the left and right suspension arms (71, 72), and according to the present invention, the weight can be reduced and the cost can be reduced when compared with a conventional tricycle (10) wherein a shock absorber (76) is provided for each of the left and right suspension arms (71, 72).

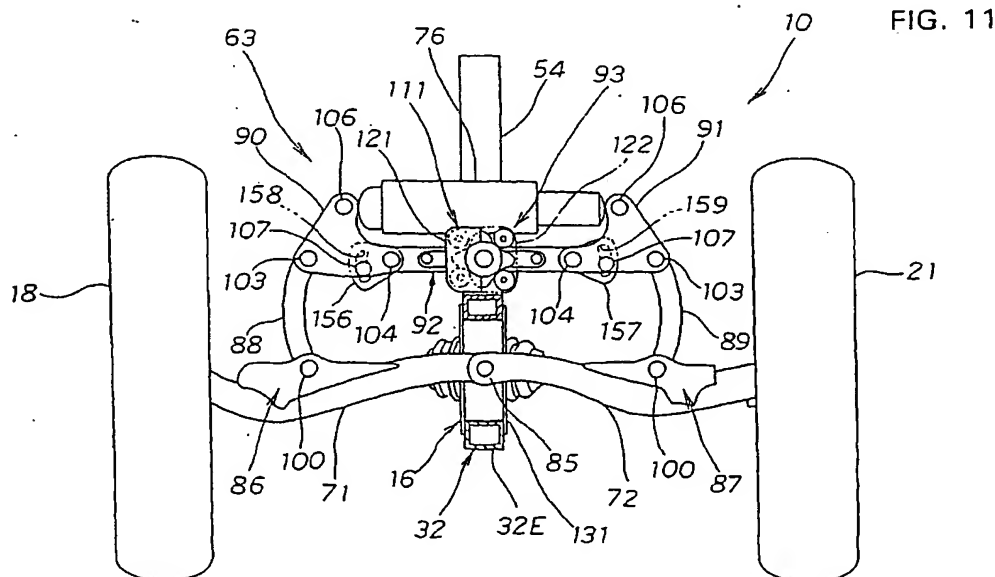


FIG. 11

## Description

[0001] This invention relates to a tricycle with a rocking mechanism wherein a single shock absorber can be used for both of left and right suspensions for rear wheels independent of each other to achieve reduction of the weight and reduction of the cost.

[0002] As a suspension for a vehicle, one disclosed, for example, in the official gazette of Japanese Patent Publication No. Hei 5-87430 "Saddle Type Four Wheel Car for Running on an Irregular Ground" is known.

[0003] FIG. 6 of the official gazette mentioned is described below with reference to FIG. 17. It is to be noted that renumbered reference numerals are used in FIG. 17.

[0004] FIG. 17 is a sectional view showing the conventional suspension and shows a wishbone type front suspension 207 wherein a lower arm 203 and an upper arm 204 extend between a vehicle body 200 side and a knuckle 202 on which a front wheel 201 is supported for rotation and a progressive link 205 is mounted at an upper portion of the upper arm 204 while a shock absorber 206 is mounted between an end of the progressive link 205 and a vehicle body 200. It is to be noted that also another front suspension on which the other front wheel 201 is suspended is similar to the front suspension 207. It is to be noted that reference numerals 211 and 212 denote each a king pin.

[0005] The front wheels 201, 201 are suspended independently of each other between the left and right sides and the shock absorbers 206 are provided individually on the left and right. If the shock absorbers are combined into a single shock absorber which can provide damping actions for the left and right front wheels 201, 201, then the weight can be reduced and the cost can be reduced.

[0006] Therefore, it is an object of the present invention to improve a tricycle with a rocking mechanism to form a single shock absorber for left and right rear wheel suspensions independent of each other to achieve reduction of the weight and reduction of the cost.

[0007] In order to attain the object described above, according to claim 1, a tricycle with a rocking mechanism wherein a pair of suspension arms extending leftwardly and rightwardly from a body frame and rear wheels are mounted for upward and downward movement independently of each other on the suspension arms, and a rocking mechanism for permitting leftward and rightward rocking movement of the body frame with respect to the suspension arms side is provided between the suspension arms side and the body frame side, is characterized in that the left and right suspension arms are connected to each other by resilient means and connection means provided at the opposite ends of the resilient means.

[0008] In response to upward and downward movement of the left and right suspension arms, the single resilient means can be expanded and contracted

through the connection means to effect damping action of the left and right suspension arms, and according to the present invention, the weight can be reduced and the cost can be reduced when compared with the conventional tricycle wherein a shock absorber is provided for each of the left and right suspension arms.

[0009] According to claim 2, the tricycle with a rocking mechanism is characterized in that the connection means includes links mounted for swinging movement on the suspension arms and substantially L-shaped bell cranks mounted for swinging movement at ends of the links, and where a first fulcrum is provided at a bent portion of each of the bell cranks and second and third fulcra are provided at the two end portions of each of the bell cranks, the first fulcra are mounted at the ends of the links and the second fulcra are mounted on the body frame side while the third fulcra are mounted at the end portions of the resilient means.

[0010] In response to upward and downward movements of the suspension arms, the bell cranks can be swung through the links, and the resilient means provided between the left and right bell cranks can be expanded and contracted. Consequently, damping action can be performed with the single resilient means.

[0011] According to claim 3, the tricycle with a rocking mechanism is characterized in that the left and right bell cranks are connected at the second fulcra thereof to end portions of a connection member while a middle portion of the connection members is mounted for swinging movement on the body frame, and the connection member and the resilient means are disposed substantially in parallel to each other.

[0012] A parallel link mechanism can be formed from the left and right suspension arms, left and right links, left and right bell cranks and connection member, and when the body frame rocks leftwardly and rightwardly, the distance between the third fulcra of the left and right bell cranks can be kept fixed and the resilient means is not expanded nor contracted at all. Consequently, rocking movement of the body frame does not have an influence upon the damping action of the resilient means.

[0013] According to claim 4, the tricycle with a rocking mechanism is characterized in that the resilient means is disposed above the connection member.

[0014] If the suspension arms swing upwardly, then the distance between the third fulcra of the bell cranks decreases. Therefore, since the resilient means is used in a form of use similar to that of shock absorbers disposed on the left and right as in the conventional tricycle, according to the present invention, a conventional shock absorber can be diverted, and there is no necessity to design a shock absorber newly and an increase of the cost can be suppressed.

[0015] Further, the resilient means can be covered from below with the connection member, and splashed mud, a flying stone and so forth to the resilient means can be prevented.

[0016] An embodiment of the present invention is de-

scribed below with reference to the accompanying drawings, in which:

FIG. 1 is a side elevational view of a tricycle with a rocking mechanism according to the present invention.

FIG. 2 is a side elevational view of essential part of the tricycle according to the present invention.

FIG. 3 is a plan view of the tricycle according to the present invention.

FIG. 4 is a plan view of essential part of the tricycle according to the present invention.

FIG. 5 is a first perspective view of the tricycle according to the present invention.

FIG. 6 is a rear elevational view of the tricycle according to the present invention.

FIG. 7 is a second perspective view of the tricycle according to the present invention.

FIG. 8 is a schematic view of a rocking mechanism according to the present invention.

FIG. 9 is a third perspective view of the tricycle according to the present invention.

FIG. 10 is a plan view of a body frame according to the present invention.

FIG. 11 is a rear elevational view of a rear suspension according to the present invention.

FIG. 12 is a first action diagram illustrating action of the rear suspension according to the present invention.

FIG. 13 is a second action diagram illustrating action of the rear suspension according to the present invention.

FIG. 14 is a third action diagram illustrating action of the rear suspension according to the present invention.

FIG. 15 is a fourth action diagram illustrating action of the rear suspension according to the present invention.

FIG. 16 is a fifth action diagram illustrating action of the rear suspension according to the present invention.

FIG. 17 is a sectional view showing a conventional

suspension.

[0017] It is to be noted that the drawings should be viewed in the direction of reference characters.

5 [0018] FIG. 1 is a side elevational view of a tricycle with a rocking mechanism according to the present invention, and a tricycle 10 with a rocking mechanism (hereinafter referred to simply as "tricycle 10") includes a front fork 12 mounted for steering operation on a head pipe 11 through a handle shaft not shown, a front wheel 13 mounted at a lower end of the front fork 12, a handle bar 14 integrally mounted on the front fork 12, a body frame 16 mounted at a rear portion of the head pipe 11, a power unit 17 mounted at a rear portion of the body frame 16, left and right rear wheels 18 and 21 (the rear wheel 21 on the far side is not shown) for being driven by the power unit 17, an accommodation box 22 mounted at an upper portion of the body frame 16, and a seat 23 mounted for opening and closing movement at an upper portion of the accommodation box 22.

10 [0019] The body frame 16 includes a down pipe 25 extending obliquely downwardly rearwards from the head pipe 11, a pair of left and right lower pipes 26 and 27 (the far side lower pipe 27 is not shown) extending further obliquely upwardly rearwards from a lower portion of the down pipe 25, a center upper frame 28 connected to rear portions of the lower pipes 26 and 27, a center pipe 31 extending rearwardly from the down pipe 25 and connected to the center upper frame 28, and a J frame 32 having a J shape in side elevation and connected to rear portions of the lower pipes 26 and 27 and a rear portion side of the center upper frame 28.

15 [0020] The center upper frame 28 is a member on which the accommodation box 22 is supported and the power unit 17 is suspended.

20 [0021] The J frame 32 is a member to which a rear suspension on which the rear wheels 18 and 21 are suspended and a rocking mechanism for permitting leftward and rightward rocking movement of the body frame 16 side with respect to the rear suspension side. The rear suspension and the rocking mechanism are hereinafter described in detail.

25 [0022] The power unit 17 includes an engine 34 disposed on the front side of the vehicle body, and a power transmission mechanism 35 for transmitting power of the engine 34 to the rear wheels 18 and 21.

30 [0023] Here, reference numeral 41 denotes a front fender which covers the front wheel 13 from above, 42 a battery, 43 a winker, 44 a tail lamp, 46 an air cleaner, and 47 a muffler.

35 [0024] FIG. 2 is a side elevational view of essential part of the tricycle according to the present invention and shows that connection pipes 52, 52 (the far side connection pipe 52 is not shown) extend between the J frame 32 and the center upper frame 28 in order to connect an upper portion of the J frame 32 and a rear end of the center upper frame 28 to each other; that reinforcement plates 53, 53 are mounted on the connection

pipes 52, 52 and the center upper frame 28; that an L pipe 54 having a substantially L shape in side elevation is mounted on the inner side of a rear portion of the J frame 32; that brackets 56, 56 (the bracket 56 on the far side is not shown) are mounted on the center upper frame 28; that the power unit 17 is mounted at a front upper portion thereof on the brackets 56, 56 through a relaying member 57; that a support rod 58 extends obliquely rearwardly downwards from the reinforcement plates 53, 53 to support a rear portion of the power unit 17; and that a projection 61 extends forwardly from a front portion of the L pipe 54 to mount a rear end portion of the power unit 17. It is to be noted that reference characters 32A, 32B and 32C denote a lower horizontal portion of the J frame 32 which extends substantially horizontally, a rear end inclined portion of the J frame 32 having an upper end side displaced rearwardly with respect to a lower end side and an upper inclined portion of the J frame 32 having a front end portion displaced upwardly with respect to a rear end portion, respectively.

[0025] FIG. 3 is a plan view of the tricycle according to the present invention and shows that a rear portion of the J frame 32 is formed from a single pipe and a rear suspension 63 (details of which are hereinafter described) is mounted on the J frame 32. It is to be noted that reference numeral 65 denotes a brake lever for the rear wheel, and 66 a brake lever for the front wheel.

[0026] FIG. 4 is a plan view of essential part of the tricycle according to the present invention and shows that the tricycle is structured such that suspension arms 71 and 72 are mounted on the left and right of the J frame 32 and a holder (not shown) is mounted at an end of each of the suspension arms 71 and 72 while the rear wheels 18 and 21 are mounted for rotation on the holders and are driven by drive shafts 73 and 74 extending from the power transmission mechanism 35 of the power unit 17.

[0027] Reference numeral 76 denotes a shock absorber serving as resilient means composed of a damper 77 and a compression coil spring (not shown), and the shock absorber 76 is connected to the left and right suspension arms 71 and 72.

[0028] The center upper frame 28 is a substantially elliptical member, and the accommodation box 22 (refer to FIG. 1) having a bottom of the substantially same shape is mounted at an upper portion of the center upper frame 28.

[0029] The power transmission mechanism 35 of the power unit 17 includes a non-stage transmission 78 of the belt type extending rearwardly from a left rear portion of the engine 34 and a gear box 81 connected to a rear portion of the non-stage transmission 78. The drive shaft 74 is connected to a front side output power shaft of the gear box 81 while the drive shaft 73 is connected to a rear side output power shaft of the gear box 81.

[0030] FIG. 5 is a first perspective view of the tricycle according to the present invention and shows that the J frame 32 is mounted at a front portion thereof to rear

portions of the lower pipes 26 and 27 of the body frame 16. It is to be noted that reference numeral 83 denotes a holder (the far side holder 83 is not shown).

[0031] FIG. 6 is a rear elevational view of the tricycle according to the present invention, and the rear end inclined portion 32B of the J frame 32 is a portion which extends substantially vertically in a state wherein no person gets on the tricycle 10 and the suspension arms 71 and 72 are mounted at rear portions thereof to the rear end inclined portion 32B. It is to be noted that reference numeral 85 denotes a rear swing shaft for mounting rear portions of the suspension arms 71 and 72 for swinging movement on the rear end inclined portion 32B.

[0032] FIG. 7 is a second perspective view of the tricycle according to the present invention and shows the rear suspension 63 wherein the suspension arms 71 and 72 extend leftwardly and rightwardly from the J frame 32; the holders 83, 83 are mounted at ends of the suspension arms 71 and 72; arcuate links 88 and 89 serving as connection means are mounted for swinging movement at upper portions of the suspension arms 71 and 72 through mounting brackets 86 and 87, respectively; bell cranks 90 and 91 each having a substantially L-shape in side elevation and serving as connection means are mounted for swinging movement at ends of the arcuate links 88 and 89, respectively; the shock absorber 76 extends between upper end portions of the bell cranks 90 and 91; a bar-like connection member 92 extends between side end portions of the bell cranks 90 and 91; and the connection member 92 is mounted on the rear end inclined portion 32B of the J frame 32 through a rocking mechanism 93.

[0033] The arcuate links 88 and 89 are members each of which has a side projection 95 at a middle portion thereof and on which brake calipers 96, 96 for braking the swinging movement of the arcuate links 88 and 89 are mounted. It is to be noted that reference numerals 97, 97 denote brake apparatus which include the brake calipers 96, 96 and disks 98, 98 are hydraulically sandwiched by the brake calipers 96, 96. The disks 98, 98 are members individually mounted on the suspension arms 71 and 72. Reference numeral 100 denotes a bolt serving as a shaft for swinging movement of the arcuate links 88 and 89.

[0034] Each of the bell cranks 90 and 91 is composed of two crank plates 102, 102 and includes a first bolt 103 serving as a first fulcrum, a second bolt 104 serving as a second fulcrum and a third bolt 106 serving as a third fulcrum. It is to be noted that reference numeral 107 denotes a fourth bolt serving as a stopper pin for restricting the swinging movement of the connection member 92, and reference numeral 108, ... (... denotes a plural number. This similarly applies to the following description) denotes nuts screwed in the first bolt 103 to fourth bolt 107.

[0035] The rocking mechanism 93 permits, upon cornering or the like, leftward and rightward rocking movement of the body frame 16 with respect to the suspen-

sion arms 71 and 72 and increases reactive force by a resilient member built therein as the inclination of the rocking movement increases thereby to return the body frame 16 to its initial position.

(a) to (c) of FIG. 8 are schematic views of the rocking mechanism according to the present invention, and (a) is a side elevational view (partial sectional view), (b) a sectional view taken along line b-b of (a), and (c) an action diagram with respect to (b).

[0036] Referring to (a), the rocking mechanism 93 is a so-called "Neidhardt damper" which includes a case 111 mounted on the rear end inclined portion 32B of the J frame 32 and a rear portion of the L pipe 54, damper rubber members 112, ... accommodated in the case 111, a pressing member 113 mounted on the connection member 92 for pressing the damper rubber members 112, ..., and a through-pin 116 extending through the pressing member 113 and the connection member 92 and supported at the opposite end portions thereof by an end supporting portion 114 provided on the L pipe 54 and the rear end inclined portion 32B. It is to be noted that reference numeral 117 denotes a mounting portion provided on the pressing member 113 for mounting the pressing member 113 on the connection member 92 by means of a bolt, and 118 a swing restriction portion provided integrally on the end supporting portion 114 for restricting the amount of the swinging movement of the connection member 92.

[0037] Referring to (b), the case 111 is a member composed of a left case 121 and a right case 122 joined together and has a damper accommodation chamber 123 provided in the inside thereof. The damper rubber members 112, ... are disposed at the four corners of the damper accommodation chamber 123 and are pressed by convex pressing portions 124, ... of the pressing member 113.

[0038] Referring to (c), if the body frame 16 is rocked leftwardly of the vehicle body (an arrow mark left in the figure denotes the leftward direction of the vehicle body) with respect to the connection member 92 connected to the suspension arms side until the L pipe 54 is inclined by an angle  $\theta$ , then the case 111 of the rocking mechanism 93 turns relative to the pressing member 113, whereupon the damper rubber members 112, ... accommodated in the case 111 are sandwiched between and compressed by the case 111 and the pressing member 113 and exert reactive force to return the case 111 and hence the body frame 16 to their initial positions (the positions of (b)).

[0039] FIG. 9 is a third perspective view of the tricycle according to the present invention (a view as viewed from obliquely rearwardly of the body frame) and shows that a rear mounting portion 127 for mounting rear portions of the suspension arms 71 and 72 (refer to FIG. 7) for swinging movement and a front mounting portion 128 for mounting front portions of the suspension arms 71

and 72 for swinging movement on the J frame 32.

[0040] The rear mounting portion 127 includes the rear end inclined portion 32B and a vertical bracket 131 extending downwardly from the L pipe 54 to a lower horizontal portion 32E (hereinafter described), and a rear swing shaft (refer to FIG. 6) for supporting rear portions of the suspension arms 71 and 72 is mounted on each of the rear end inclined portion 32B and the vertical bracket 131.

[0041] The front mounting portion 128 includes a front upright portion 133 and a rear upright portion 134 spaced from each other and erected uprightly on the lower horizontal portion 32E, and a front swing shaft 136 for supporting front portions of the suspension arms 71 and 72 is mounted on each of the front upright portion 133 and the rear upright portion 134.

[0042] Here, reference numeral 138 denotes a fuel tank, reference numerals 142 and 143 denote engine mount link vibration isolators for carrying the engine 34 on the body frame 16, and reference numeral 144 denotes a U-shaped U pipe mounted at rear lower portions of the lower pipes 26 and 27 for mounting an end of the lower horizontal portion 32E of the J frame 32.

[0043] While FIG. 5 shows an embodiment wherein a front end of the lower horizontal portion 32A bifurcated in a Y shape is mounted directly on the lower pipes 26 and 27, FIG. 9 shows another embodiment wherein the J frame 32 is formed from a lower horizontal portion 32E bifurcated in a Y shape, a rear end inclined portion 32B, and an upper inclined portion 32C and a front end of the lower horizontal portion 32E is mounted on the lower pipes 26 and 27 through a U pipe 144.

[0044] FIG. 10 is a plan view of the body frame according to the present invention and shows that the lower horizontal portion 32E of the J frame 32 is intermediately bifurcated in a Y shape and connected to a rear portion of the U pipe 144 and the connection pipes 52, 52 extend in a Y shape from the upper inclined portion 32C of the J frame 32 to the center upper frame 28.

[0045] The lower horizontal portion 32E (and the lower horizontal portion 32A (refer to FIG. 5)) particularly is a portion formed by intermediately bending a single elongated first pipe 151 and connecting a second pipe 153 to the first pipe 151 in the proximity of a bent portion 152. It is to be noted that reference numeral 154 denotes a Y-shaped bifurcated portion connecting the second pipe 153 to the first pipe 151 and bifurcated in a Y shape, and 155 a Y-shaped bifurcated portion connecting the connection pipes 52, 52 to the upper inclined portion 32C and bifurcated in a Y shape.

[0046] The first pipe 151 is a member including the rear end inclined portion 32B and the upper inclined portion 32C and is a member formed by removing the second pipe 153 from the J frame 32.

[0047] By forming the lower horizontal portion 32E in a Y shape in this manner, the coupling between the lower front portion of the J frame 32 and the U pipe 144 can be made firm, and by disposing the connection pipes

52, 52 in a Y shape, the coupling between the rear upper portion of the J frame 32 and the rear portion of the center upper frame 28 can be made firm. Further, in FIG. 5, by forming the lower horizontal portion 32A in a Y shape, the coupling between the lower front portion of the J frame 32 and the lower pipes 26 and 27 can be made firm.

[0048] FIG. 11 is a rear elevational view of the rear suspension according to the present invention and shows the rear suspension 63 in a state wherein one passenger (driver) gets on the tricycle (this state is referred to as "1G state"). It is to be noted that the rear end inclined portion 32B and the upper inclined portion 32C of the J frame 32 shown in FIG. 9 are omitted. Further, the right case 122 of the rocking mechanism 93 shown in (b) of FIG. 8 is indicated by an imaginary line. At this time, the L pipe 54 of the body frame 16 is in a substantially vertical state, and the connection member 92 is in a substantially horizontal state.

[0049] The connection member 92 is a member which has sectoral portions 156 and 157 of a sectoral shape provided at the opposite ends thereof and has arcuate elongated holes 158 and 159 provided in the sectoral portions 156 and 157, respectively. The fourth bolts 107, 107 each serving as a stopper pin are fitted in the arcuate elongated holes 158 and 159 to restrict the inclination angles of the bell cranks 90 and 91 with respect to the connection member 92, respectively. The inclination angles of the bell cranks 90 and 91 vary depending upon the inclination angles of the suspension arms 71 and 72, that is, the amounts of upward and downward movement of the rear wheels 18 and 21, respectively. In other words, the arcuate elongated holes 158 and 159 are portions for restricting the amounts of upward and downward movement of the rear wheels 18 and 21, respectively.

[0050] Action of the rear suspension 63 described above is described below.

[0051] FIG. 12 is a first action diagram illustrating action of the rear suspension according to the present invention.

[0052] For example, if the left side rear wheel 18 moves upwardly by a movement amount M1 from the state shown in FIG. 11, then the suspension arm 71 swings upwardly as indicated by an arrow mark a around the rear swing shaft 85 and the front swing shaft 136 (refer to FIG. 9), whereupon the arcuate link 88 moves upwardly as indicated by an arrow mark b to swing the bell crank 90 in a direction of an arrow mark c around the second bolt 104 to compress the shock absorber 76 as indicated by an arrow mark d. Transmission of an impact to the body frame 16 (refer to FIG. 10) by an upward movement of the left side rear wheel 18 is moderated in this manner.

[0053] At this time, since the other suspension arm 72 is in a state same as that of FIG. 11, the connection member 92 remains in a substantially horizontal state similarly as in FIG. 11.

[0054] FIG. 13 is a second action diagram illustrating action of the rear suspension according to the present invention.

[0055] If both of the rear wheels 18 and 21 move upwardly by a movement amount M2 or the body frame 16 moves downwardly by a movement amount M2 with respect to the rear wheels 18 and 21 from the state of FIG. 11, then the suspension arms 71 and 72 swing upwardly as indicated by arrow marks f, f around the rear swing shaft 85 and the front swing shaft 136 (refer to FIG. 9), whereupon the arcuate links 88 and 89 move upwardly as indicated by arrow marks g, g to swing the bell cranks 90 and 91 in directions indicated by arrow marks h, h around the second bolt 104 to compress the shock absorber 76 as indicated by arrow marks j, j. As a result, a damping action by the shock absorber 76 is performed.

[0056] FIG. 14 is a third action diagram illustrating action of the rear suspension according to the present invention.

[0057] If both of the rear wheels 18 and 21 move downwardly by a movement amount M3 or the body frame 16 moves upwardly by a movement amount M3 with respect to the rear wheels 18 and 21 from the state of FIG. 11, then the suspension arms 71 and 72 swing downwardly as indicated by arrow marks m, m around the rear swing shaft 85 and the front swing shaft 136 (refer to FIG. 9), whereupon the arcuate links 88 and 89 move down as indicated by arrow marks n, n to swing the bell cranks 90 and 91 in directions indicated by arrow marks p, p around the second bolt 104 thereby to allow the shock absorber 76 to expand as indicated by arrow marks q, q. As a result, a damping action by the shock absorber 76 is performed.

[0058] FIG. 15 is a fourth action diagram illustrating action of the rear suspension according to the present invention.

[0059] If the body frame 16, here the L pipe 54, rocks leftwardly of the vehicle body by an angle  $\phi 1$ , then the connection member 92 connected to the L pipe 54 by the through-pin 116 moves in parallel in a leftward direction as indicated by an arrow mark s, whereupon the arcuate links 88 and 89 are inclined as indicated by arrow marks t, t and the bell cranks 90 and 91 move in parallel as indicated by arrow marks u, u. Since the distance between the third bolts 106, 106 of the bell cranks 90 and 91 does not vary, there is no expansion or contraction of the shock absorber 76.

[0060] At this time, since the body frame 16 rocks with respect to the connection member 92, reactive force for returning the body frame 16 to its original position (that is, the position of FIG. 11) by the rocking mechanism is exerted in a similar manner as described with reference to (c) of FIG. 8.

[0061] FIG. 16 is a fifth action diagram illustrating action of the rear suspension according to the present invention.

[0062] If the rear wheel 18 moves upwardly by a

movement amount M4 and the body frame 16, here the L pipe 54, rocks by an angle  $\phi 2$  leftwardly of the vehicle body from the state of FIG. 11, then the suspension arm 71 swings upwardly as indicated by an arrow mark v around the rear swing shaft 85 and the front swing shaft 136 (refer to FIG. 9) and the connection member 92 moves leftwardly as indicated by an arrow mark w. Thereupon, the arcuate link 88 moves upwardly and is inclined leftwardly while the arcuate link 89 is inclined leftwardly as indicated by an arrow mark x, and the bell crank 90 swings in the clockwise direction around the second bolt 104 and moves leftwardly while the bell crank 91 moves leftwardly. As a result, the bell crank 91 compresses the shock absorber 76 to exert damping action.

[0063] As described above with reference to FIGS. 3 and 11, according to the present invention, the tricycle 10 with a rocking mechanism wherein the suspension arms 71 and 72 extend leftwardly and rightwardly from the body frame 16 and the rear wheels 18 and 21 are mounted for upward and downward movement independently of each other on the suspension arms 71 and 72, respectively, and the rocking mechanism 93 which permits leftward and rightward rocking movement of the body frame 16 with respect to the suspension arms 71 and 72 side is provided between the rear wheels 18 and 21 side and the body frame 16 side is characterized firstly in that the left and right suspension arms 71 and 72 are connected by the shock absorber 76 and the arcuate links 88 and 89 and the bell cranks 90 and 91 which are provided as connection means at the opposite ends of the shock absorber 76.

[0064] In response to upward and downward movement of the left and right suspension arms 71 and 72, the single shock absorber 76 can be expanded and contracted to effect damping action of the left and right suspension arms 71 and 72, and according to the present invention, the weight can be reduced and the cost can be reduced when compared with the conventional tricycle wherein a shock absorber is provided for each of the left and right suspension arms 71 and 72.

[0065] According to the present invention, the tricycle 10 with a rocking mechanism is characterized secondly in that the connection means is composed of the arcuate links 88 and 89 mounted for swinging movement on the suspension arms 71 and 72 and the substantially L-shaped bell cranks 90 and 91 mounted for swinging movement at ends of the arcuate links 88 and 89 and, where the first bolts 103 are provided at bent portions of the bell cranks 90 and 91, and the second and third bolts 104 and 106 are provided at the opposite end portions of the bell cranks 90 and 91, the first bolts 103 are mounted at ends of the arcuate links 88 and 89 and the second bolts 104 are mounted on the body frame 16 side, that is, the connection member 92 mounted on the body frame 16 and besides the third bolts 106 are mounted at the end portions of the shock absorber 76.

[0066] In response to upward and downward move-

ments of the suspension arms 71 and 72, the bell cranks 90 and 91 can be swung around the second bolts 104 through the arcuate links 88 and 89, respectively, and the shock absorber 76 provided between the third bolts 106, 106 of the left and right bell cranks 90 and 91 can be expanded and contracted. Consequently, damping action can be functioned with the single shock absorber 76.

[0067] According to the present invention, the tricycle 10 with a shock absorber is characterized thirdly in that the second bolts 104 of the left and right bell cranks 90 and 91 are connected to each other by the connection member 92 while the middle portion of the connection member 92 is mounted for swinging movement on the body frame 16, particularly on the rear end inclined portion 32B of the J frame 32 and the L pipe 54 and the connection member 92 and the shock absorber 76 are disposed substantially in parallel to each other.

[0068] A parallel link mechanism can be formed from the left and right suspension arms 71 and 72, left and right arcuate links 88 and 89, left and right bell cranks 90 and 91 and connection member 92, and when body frame 16 rocks leftwardly and rightwardly, the distance between the left and right bell cranks 90 and 91 can be kept fixed and the shock absorber 76 is not expanded nor contracted at all. Consequently, rocking movement of the body frame 16 does not have an influence upon the damping action of the shock absorber 76.

[0069] According to the invention, the tricycle 10 with a shock absorber is characterized fourthly in that the shock absorber 76 is disposed above the connection member 92.

[0070] If the suspension arms 71 and 72 swing upwardly, then the bell cranks 90 and 91 swing through the arcuate links 88 and 89 and the distance between the third bolts 106, 106 of the bell cranks 90 and 91 decreases. Therefore, since the shock absorber 76 is used in a form of use similar to that of shock absorbers disposed on the left and right as in the conventional tricycle, with the rear suspension 63 of the present invention, a conventional shock absorber can be diverted, and there is no necessity to design a shock absorber newly and an increase of the cost can be suppressed.

[0071] Further, the shock absorber 76 can be covered from below with the connection member 92, and splashed mud, a flying stone and so forth to the shock absorber 76 can be prevented.

[0072] It is to be noted that the resilient member of the present invention is not limited to a shock absorber composed of a damper and a compression coil spring but may be another shock absorber which makes use of resilient force of a rubber, resin or metal material or compressed gas.

[0073] Further, the arcuate links 88 and 89 shown in FIG. 7 are shaped arcuately in order to prevent interference thereof with any other part, but may otherwise have a linear configuration if they do not interfere with any other part.

[0074] The present invention exhibits the following effects due to the configuration described above.

[0075] With the tricycle with a rocking mechanism as set forth in claim 1, the left and right suspension arms are connected to each other by resilient means and connection means provided at the opposite ends of the resilient means. Consequently, in response to upward and downward movement of the left and right suspension arms, the single resilient means can be expanded and contracted to effect damping action of the left and right suspension arms, and according to the present invention, the weight can be reduced and the cost can be reduced when compared with the conventional tricycle wherein a shock absorber is provided for each of the left and right suspension arms.

[0076] With the tricycle with a rocking mechanism as set forth in claim 2, the connection means includes links mounted for swinging movement on the suspension arms and substantially L-shaped bell cranks mounted for swinging movement at ends of the links, and where a first fulcrum is provided at a bent portion of each of the bell cranks and second and third fulcra are provided at the two end portions of each of the bell cranks, the first fulcra are mounted at the ends of the links and the second fulcra are mounted on the body frame side while the third fulcra are mounted at the end portions of the resilient means. Consequently, in response to upward and downward movements of the suspension arms, the bell cranks can be swung through the links, and the resilient means provided between the left and right bell cranks can be expanded and contracted. Consequently, damping action can be performed with the single resilient means.

[0077] With the tricycle with a rocking mechanism as set forth in claim 3, the left and right bell cranks are connected at the second fulcra thereof to end portions of a connection member while a middle portion of the connection members is mounted for swinging movement on the body frame, and the connection member and the resilient means are disposed substantially in parallel to each other. Consequently, a parallel link mechanism can be formed from the left and right suspension arms, left and right links, left and right bell cranks and connection member, and when the body frame rocks leftwardly and rightwardly, the distance between the third fulcra of the left and right bell cranks can be kept fixed and the resilient means is not expanded nor contracted at all. Consequently, rocking movement of the body frame does not have an influence upon the damping action of the resilient means.

[0078] With the tricycle with a rocking mechanism as set forth in claim 4, the resilient means is disposed above the connection member. Consequently, if the suspension arms swing upwardly, then the distance between the third fulcra of the bell cranks decreases. Therefore, since the resilient means is used in a form of use similar to that of shock absorbers disposed on the left and right as in the conventional tricycle, according

to the present invention, a conventional shock absorber can be diverted, and there is no necessity to design a shock absorber newly and an increase of the cost can be suppressed.

[0079] Further, the resilient means can be covered from below with the connection member, and splashed mud, a flying stone and so forth to the resilient means can be prevented.

SOLVING MEANS: Left and right suspension arms 71 and 72 are connected by a shock absorber 76 and arcuate links 88 and 89 and bell cranks 90 and 91 provided at the opposite ends of the shock absorber 76.

EFFECT: In response to upward and downward movement of the left and right suspension arms, the single shock absorber can be expanded and contracted to effect damping action of the left and right suspension arms, and according to the present invention, the weight can be reduced and the cost can be reduced when compared with a conventional tricycle wherein a shock absorber is provided for each of the left and right suspension arms.

## Claims

1. A tricycle with a rocking mechanism wherein a pair of suspension arms (71, 72) extending leftwardly and rightwardly from a body frame (16) and rear wheels (18, 21) are mounted for upward and downward movement independently of each other on said suspension arms (71, 72), and a rocking mechanism (93) for permitting leftward and rightward rocking movement of said body frame (16) with respect to said suspension arms (71, 72) side is provided between said suspension arms (71, 72) side and said body frame (16) side, characterized in that said left and right suspension arms (71, 72) are connected to each other by resilient means (76) and connection means (88, 89, 90, 91) provided at the opposite ends of said resilient means (76).
2. A tricycle with a rocking mechanism according to claim 1, characterized in that said connection means (88, 89, 90, 91) comprises links (88, 89) mounted for swinging movement on said suspension arms (71, 72) and substantially L-shaped bell cranks (90, 91) mounted for swinging movement at ends of said links (88, 89), and where a first fulcrum (103) is provided at a bent portion of each of said bell cranks (90, 91) and second and third fulcra (104, 106) are provided at the two end portions of each of said bell cranks (90, 91), said first fulcra (103) are mounted at the ends of said links (88, 89) and said second fulcra (104) are mounted on said body frame (16) side while said third fulcra (106) are mounted at the end portions of said resilient means

(76).

3. A tricycle with a rocking mechanism according to claim 2, **characterized in that** said left and right bell cranks (90, 91) are connected at said second fulcra (104) thereof to end portions of a connection member (92) while a middle portion of said connection members (92) is mounted for swinging movement on said body frame (16), and said connection member (92) and said resilient means (76) are disposed substantially in parallel to each other.
4. A tricycle with a rocking mechanism according to claim 3, **characterized in that** said resilient means (76) is disposed above said connection member (92).

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FIG. 1

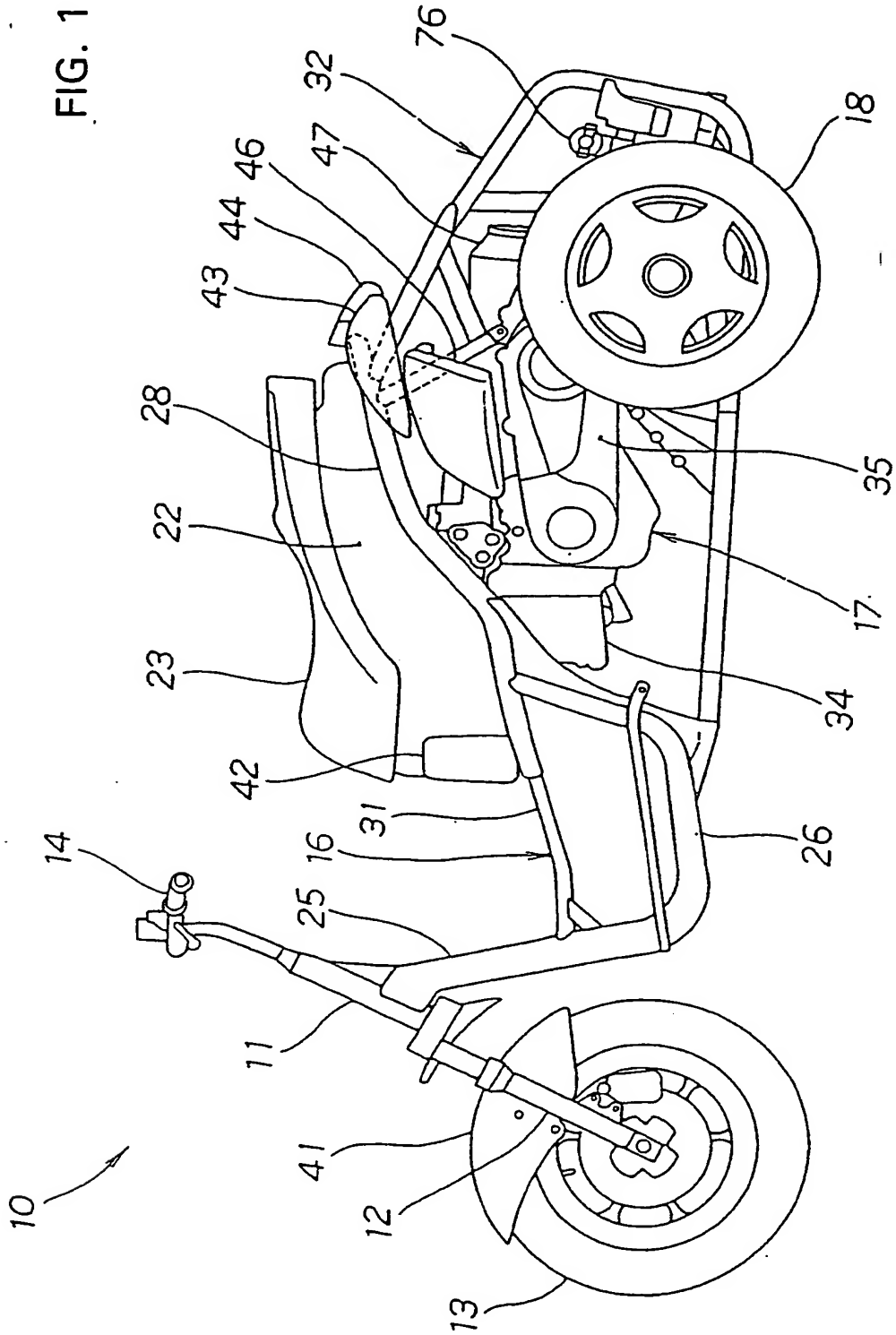


FIG. 2

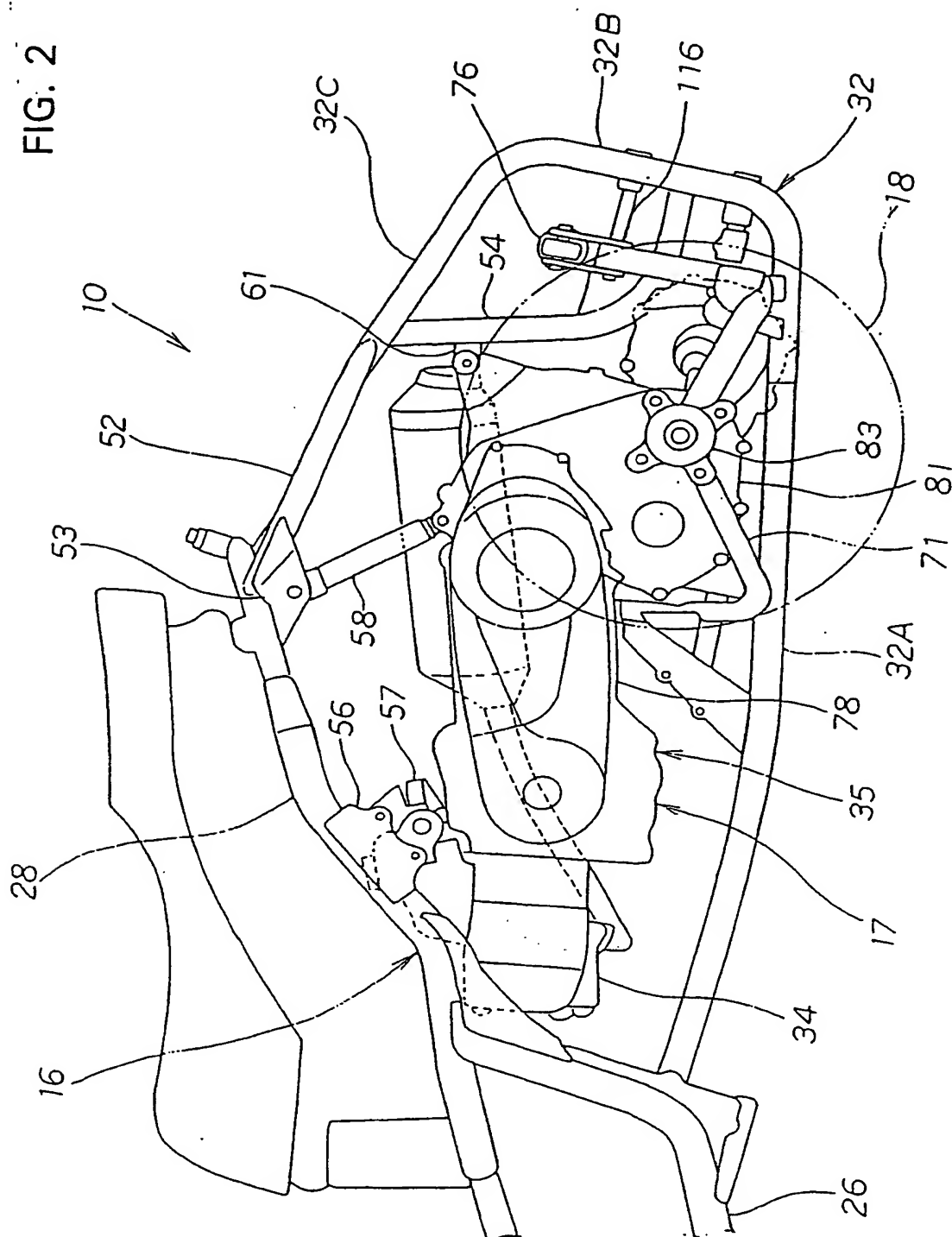


FIG. 3

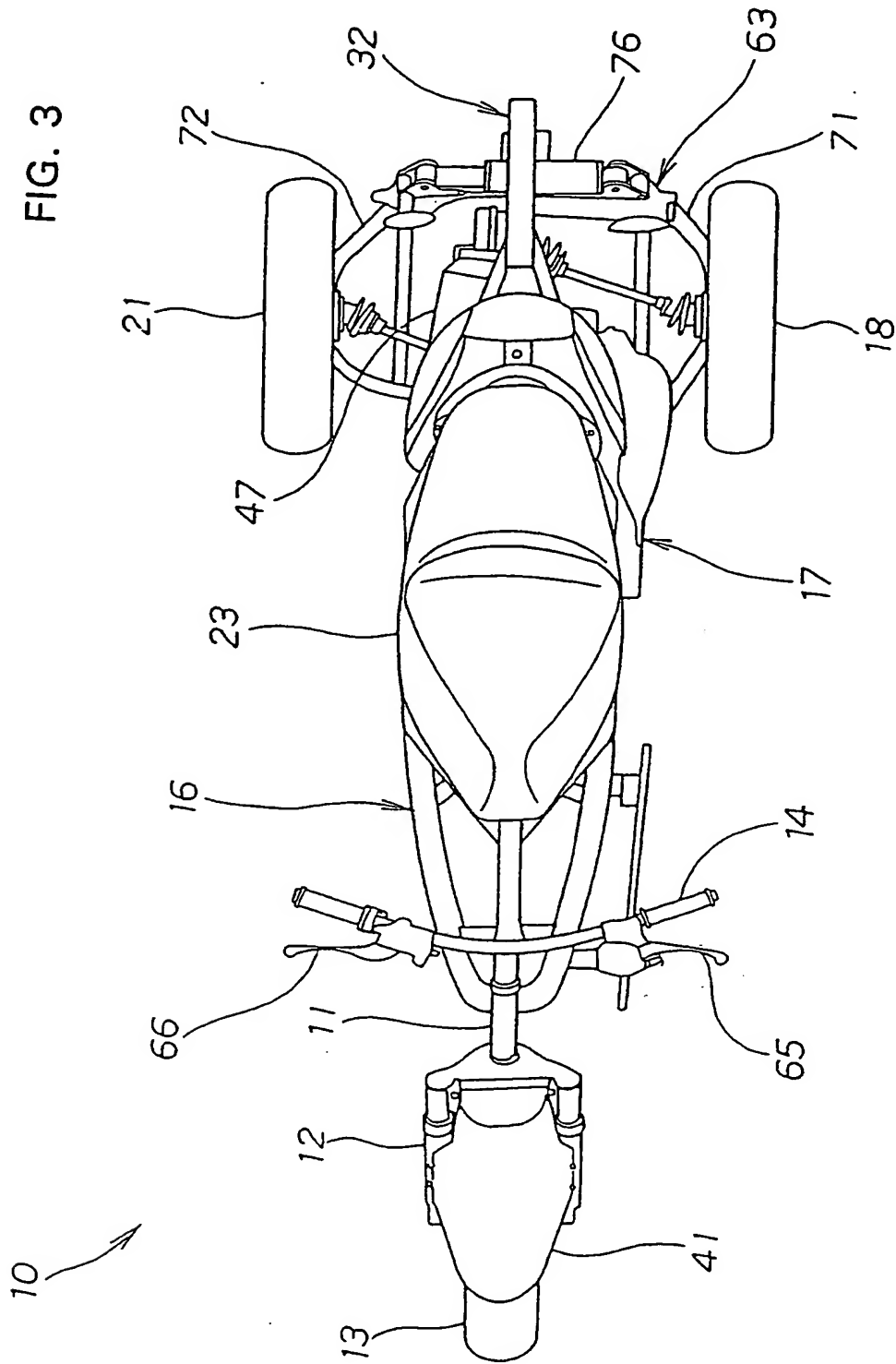


FIG. 4

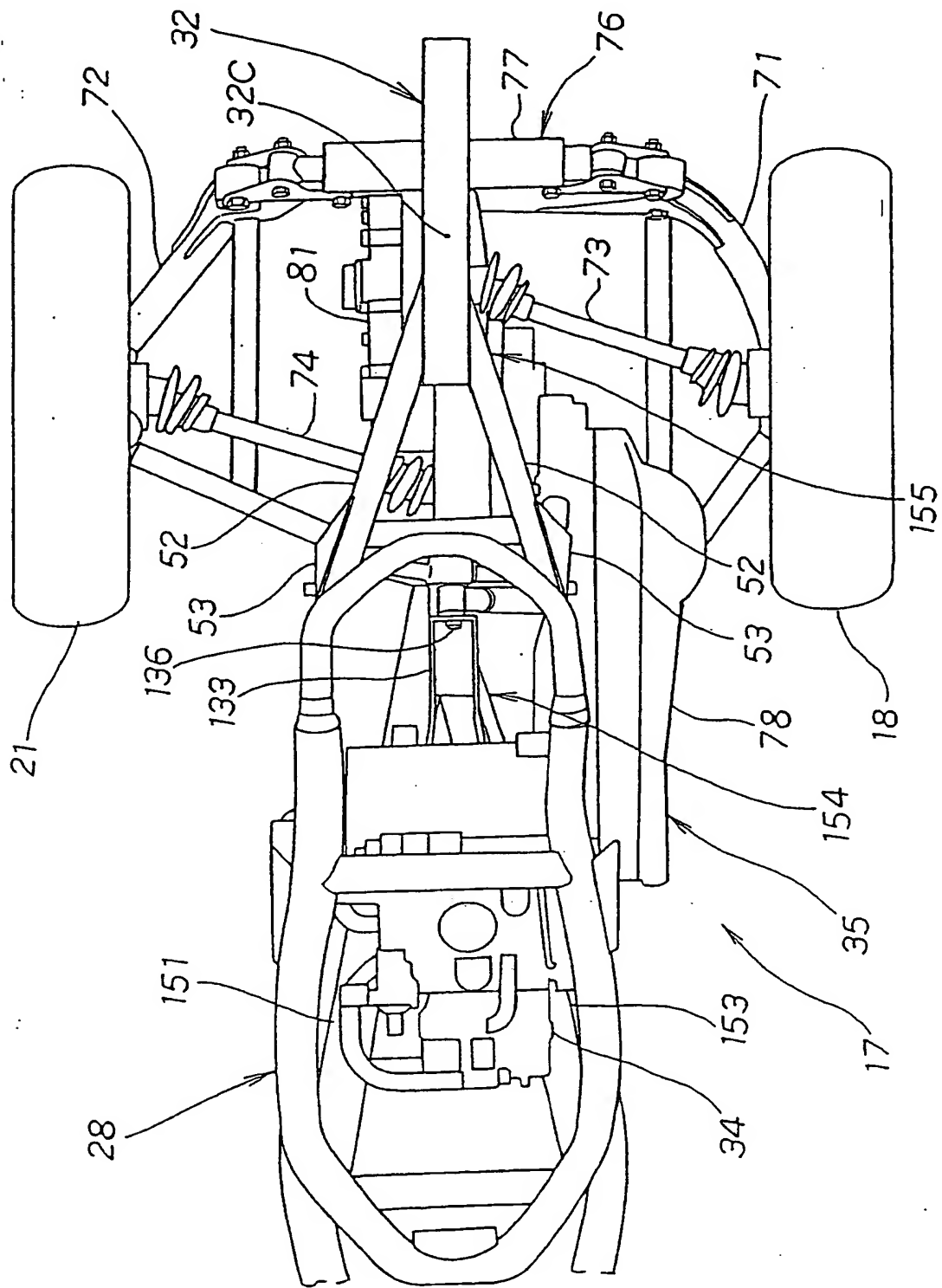


FIG. 5

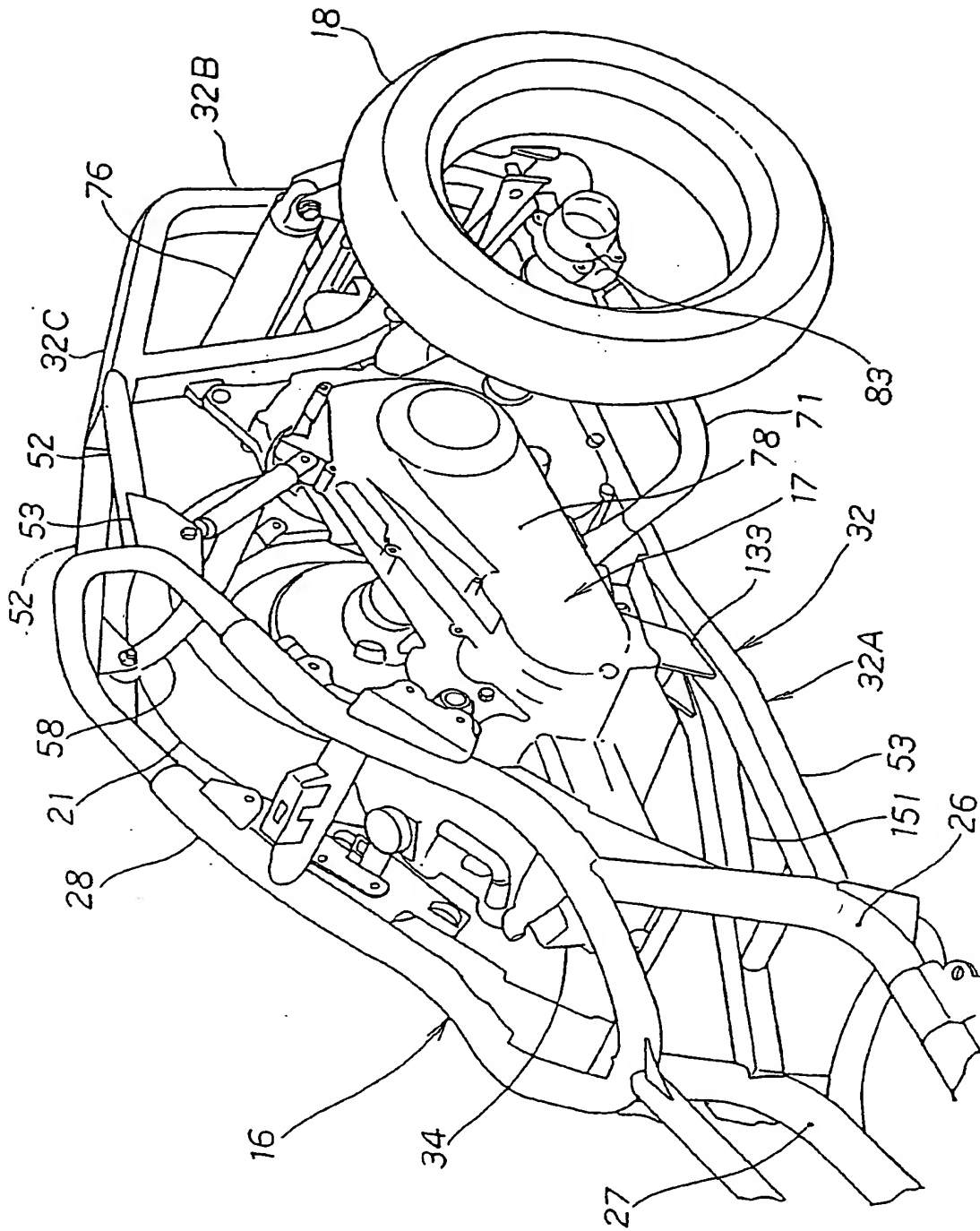


FIG. 6

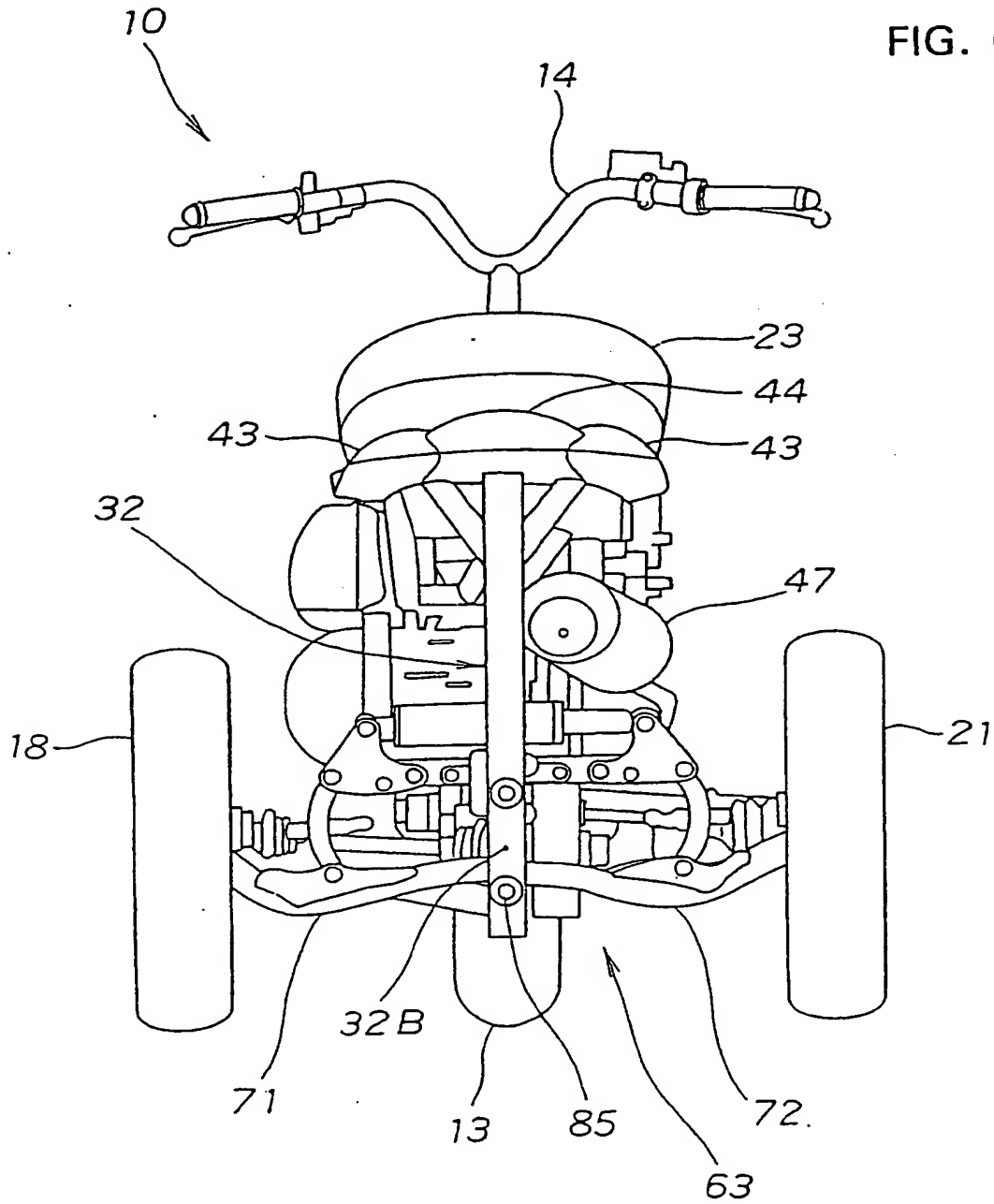


FIG. 7

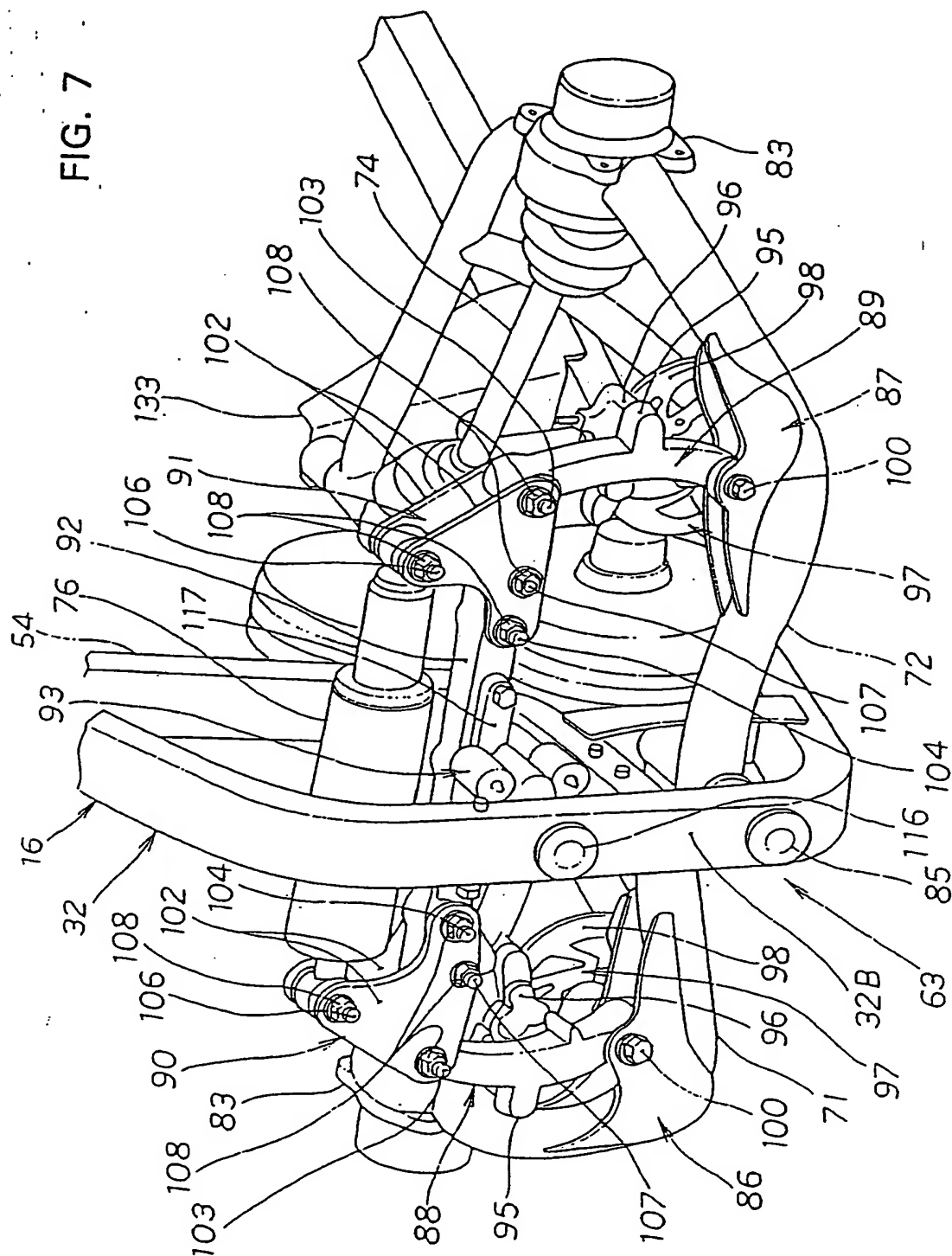


FIG. 8

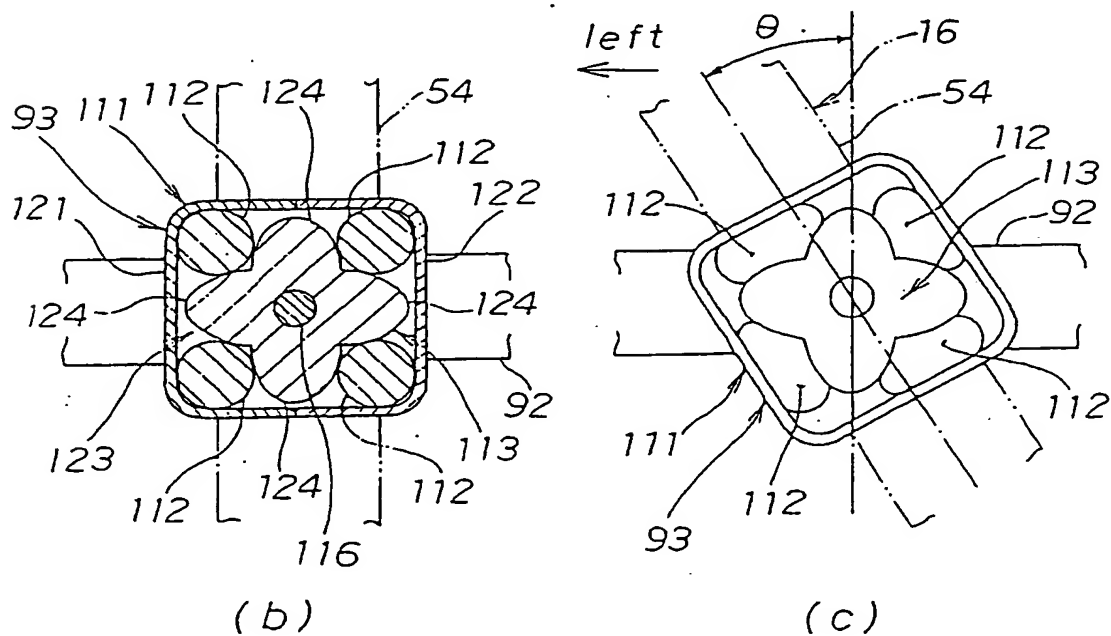
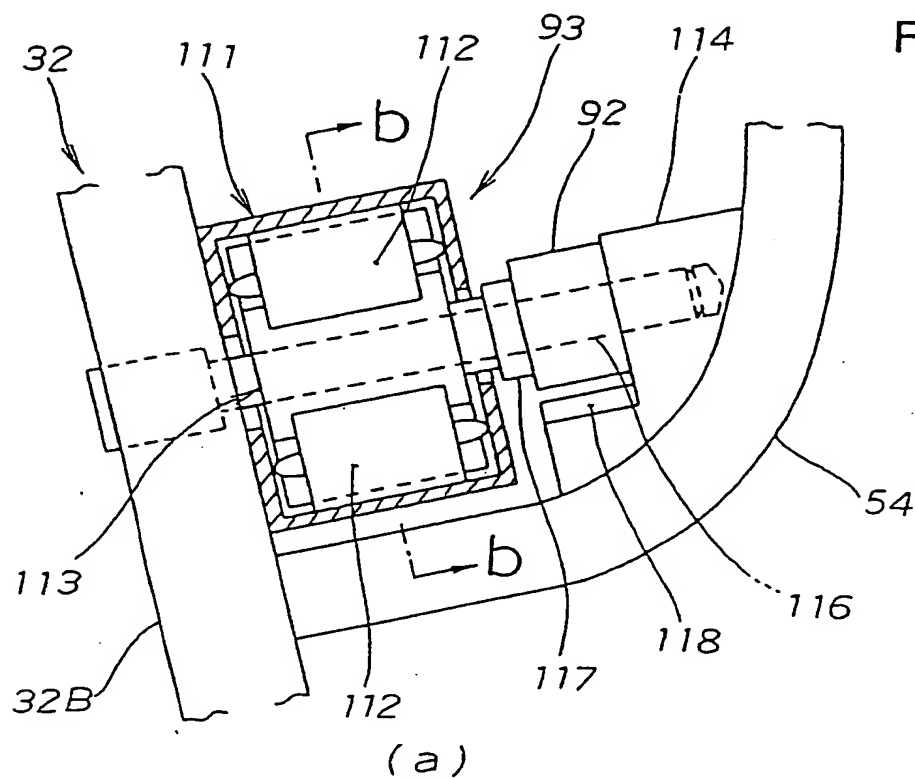


FIG. 9

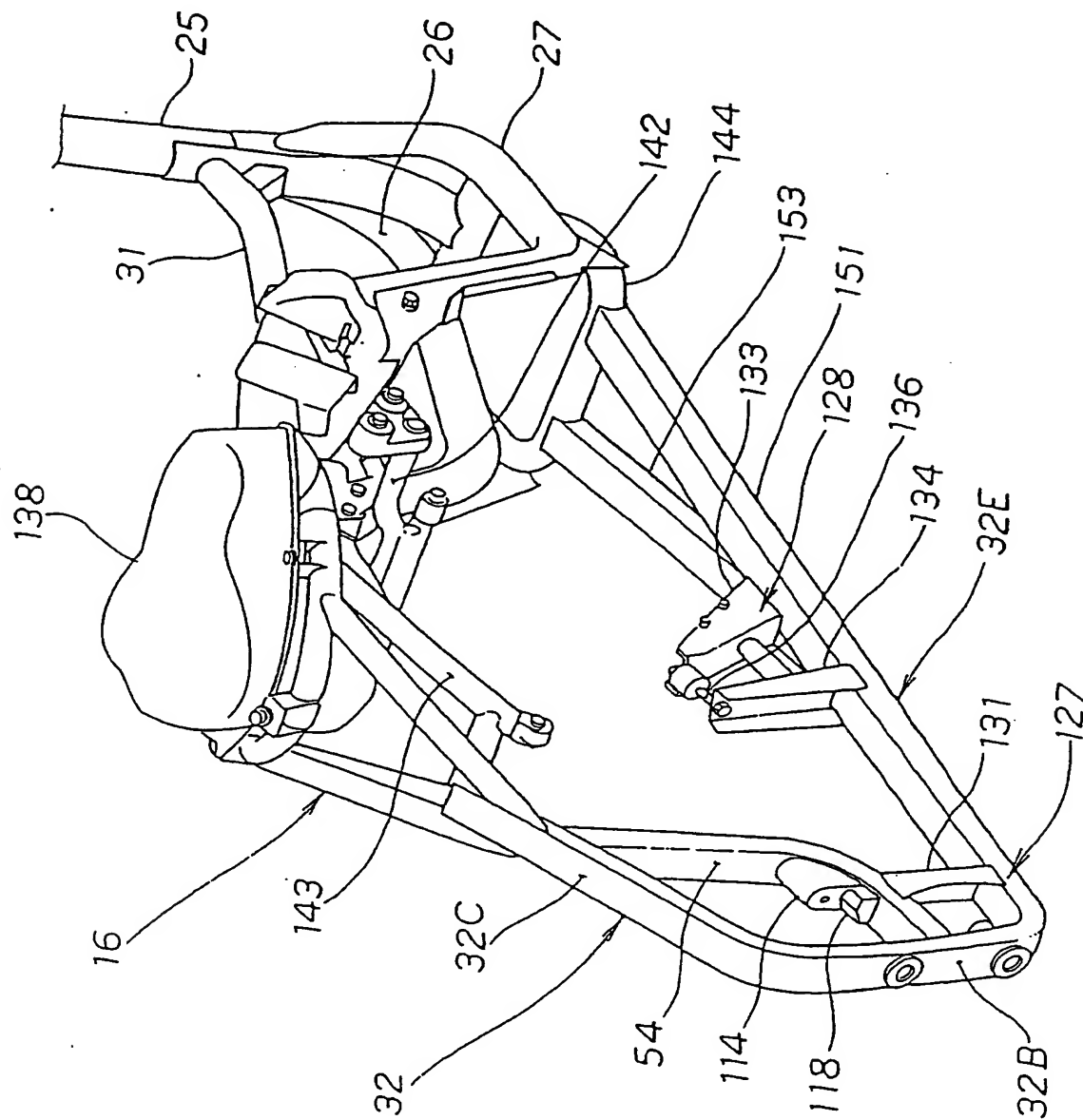


FIG. 10

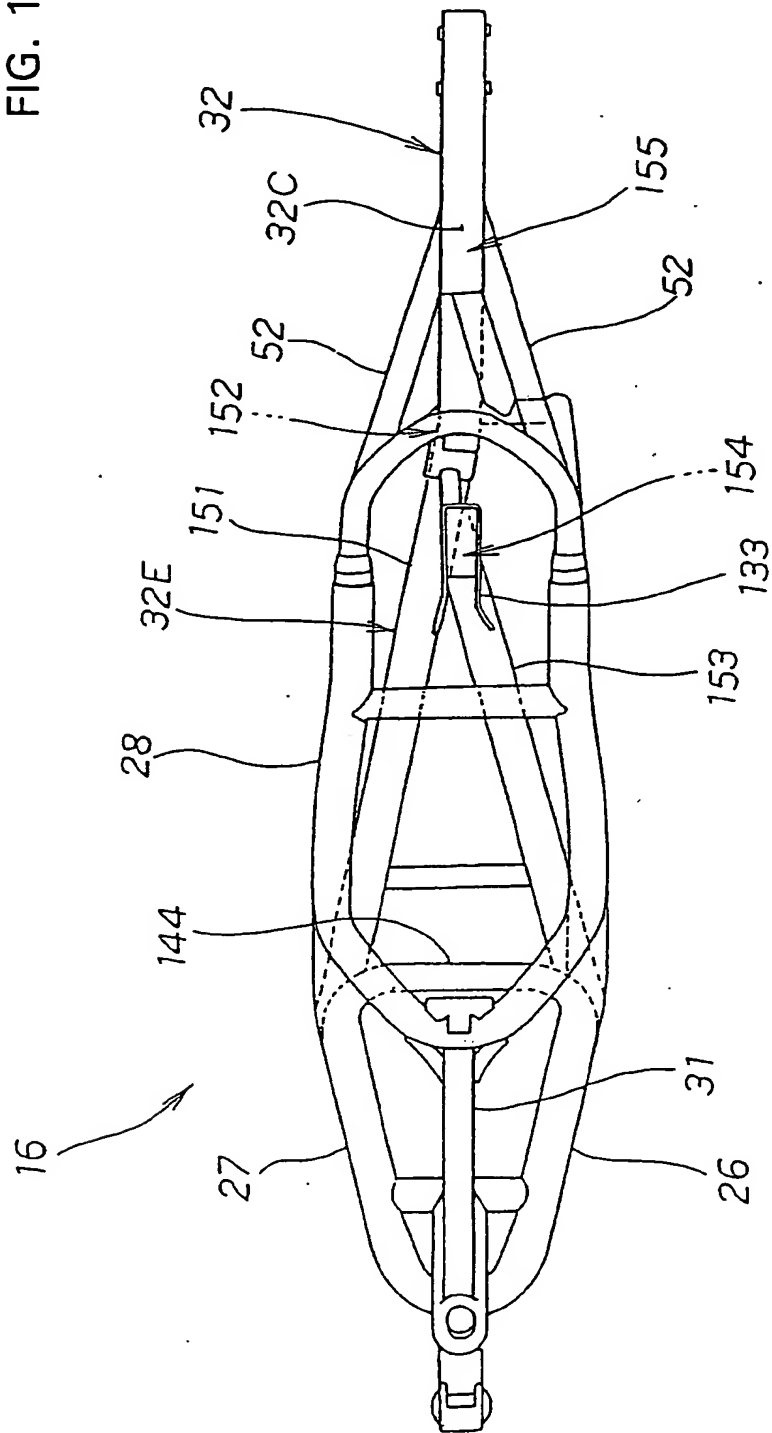


FIG. 1-1

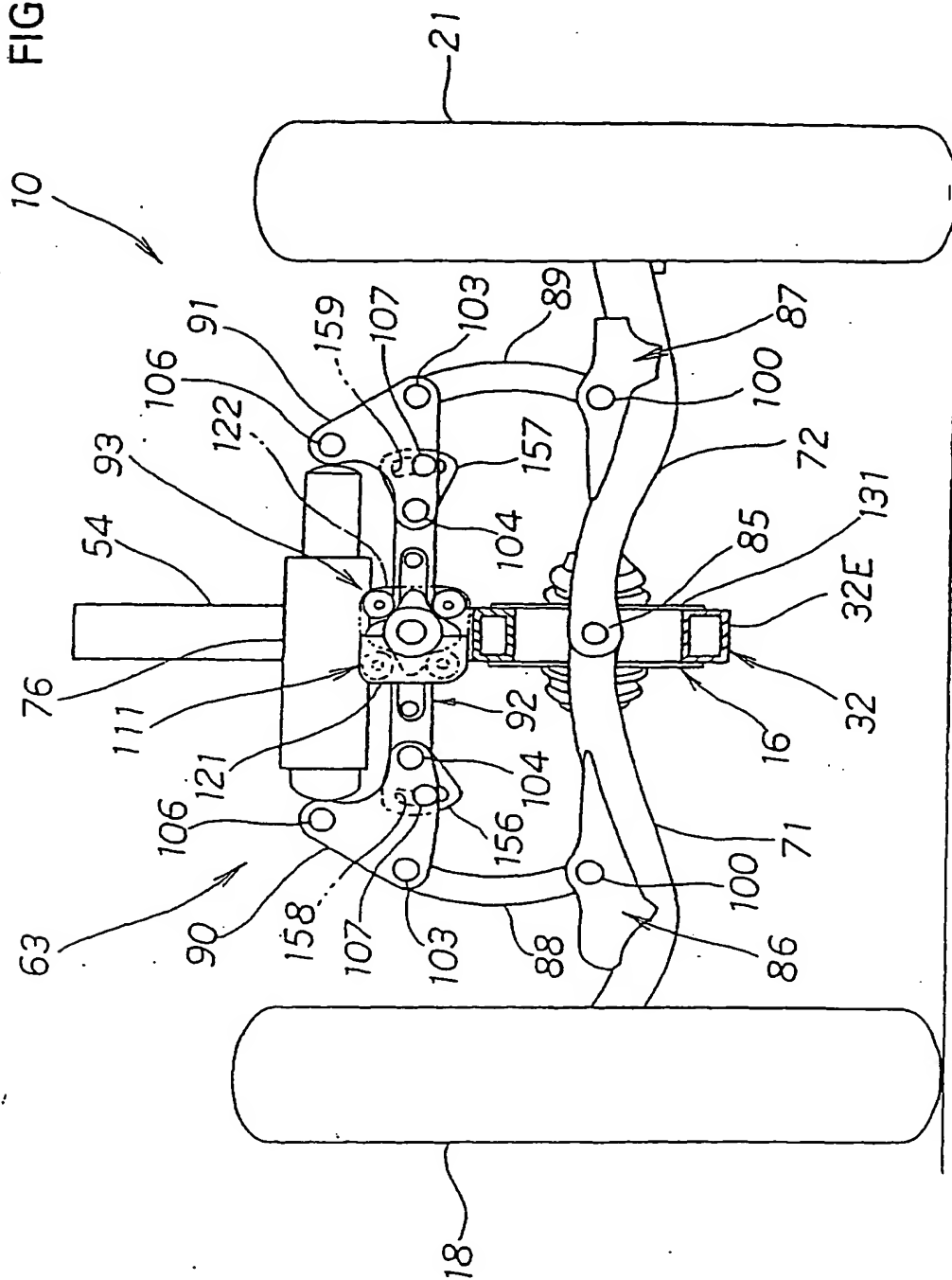


FIG. 12

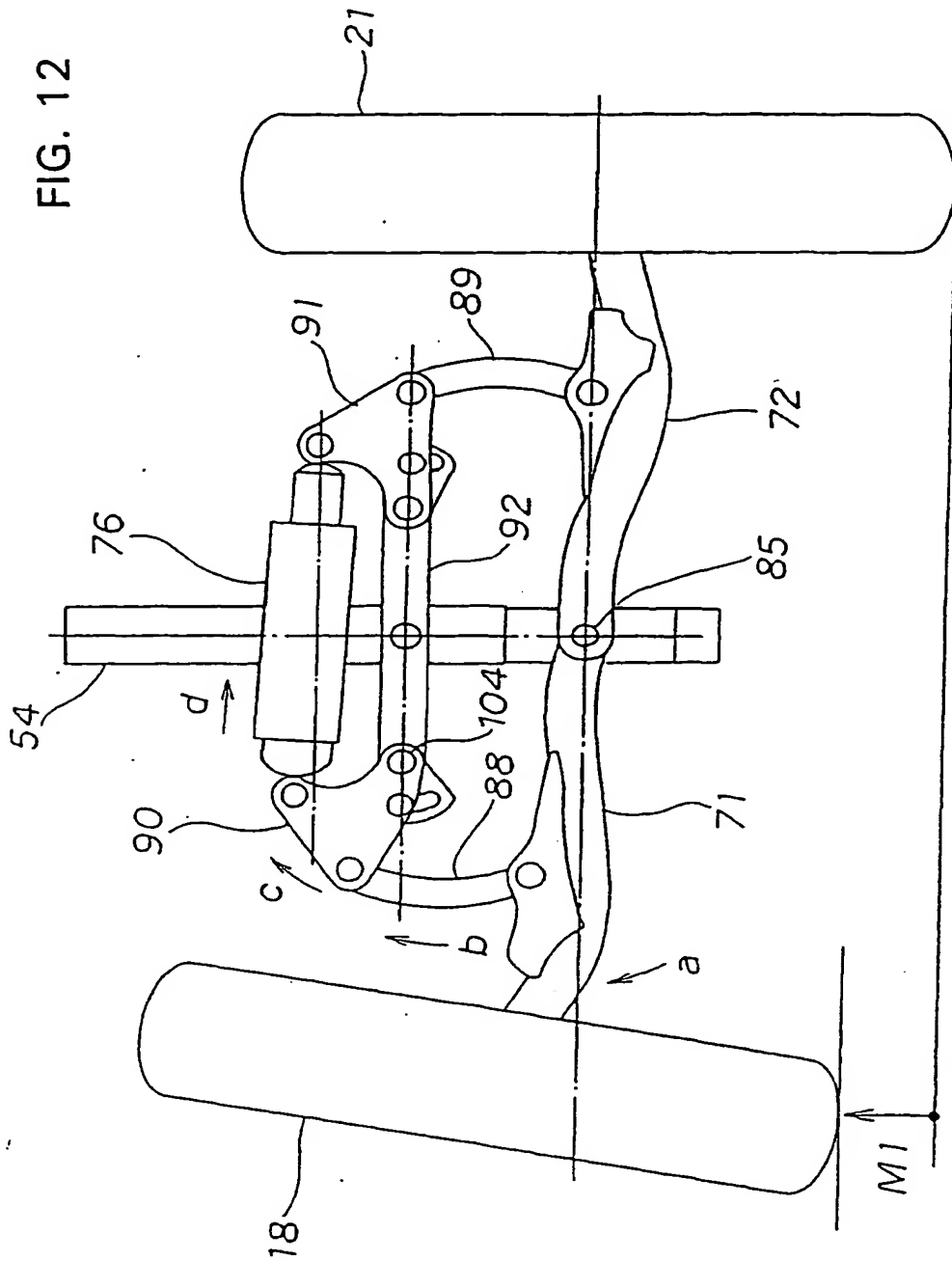


FIG. 13

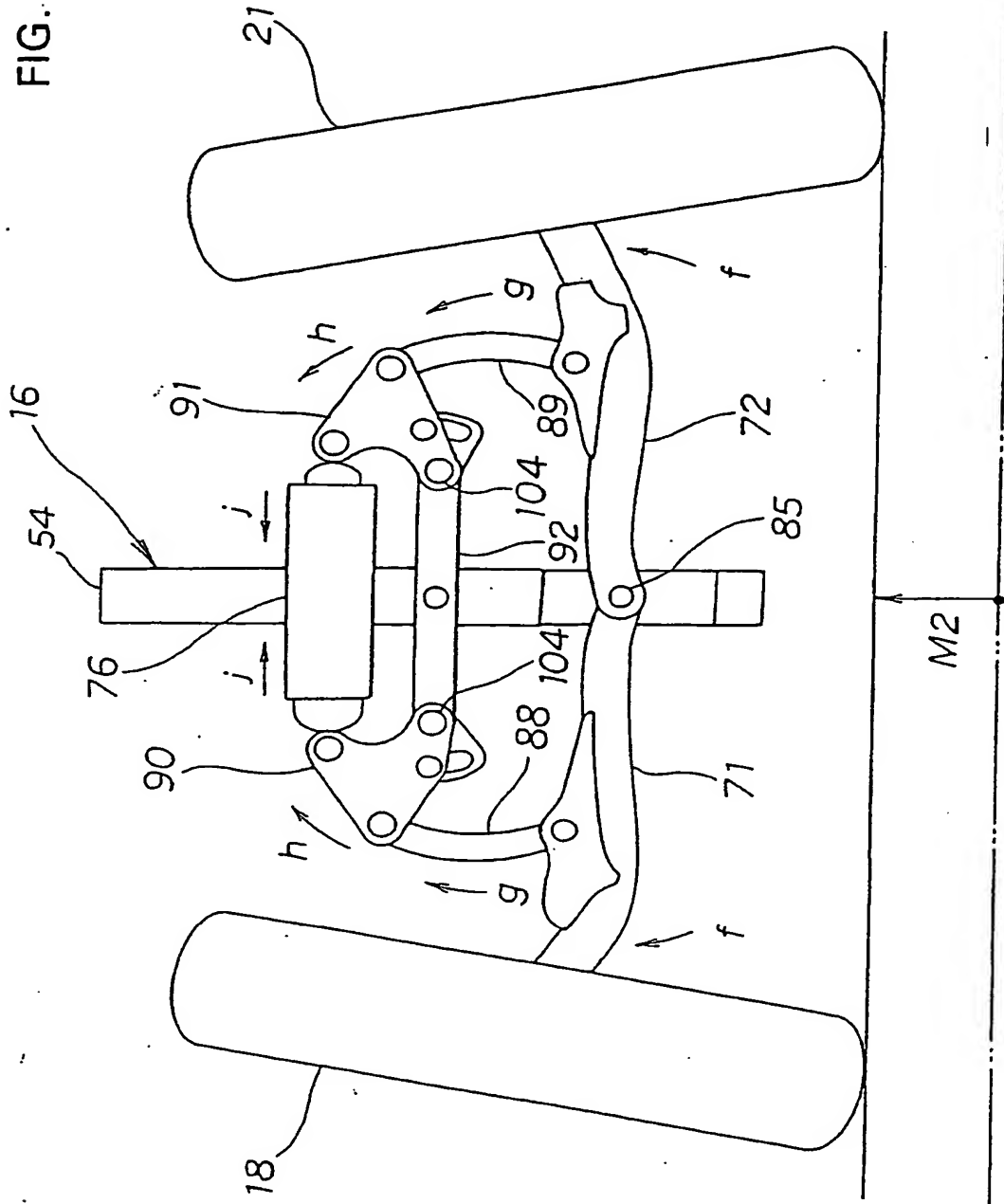


FIG. 14

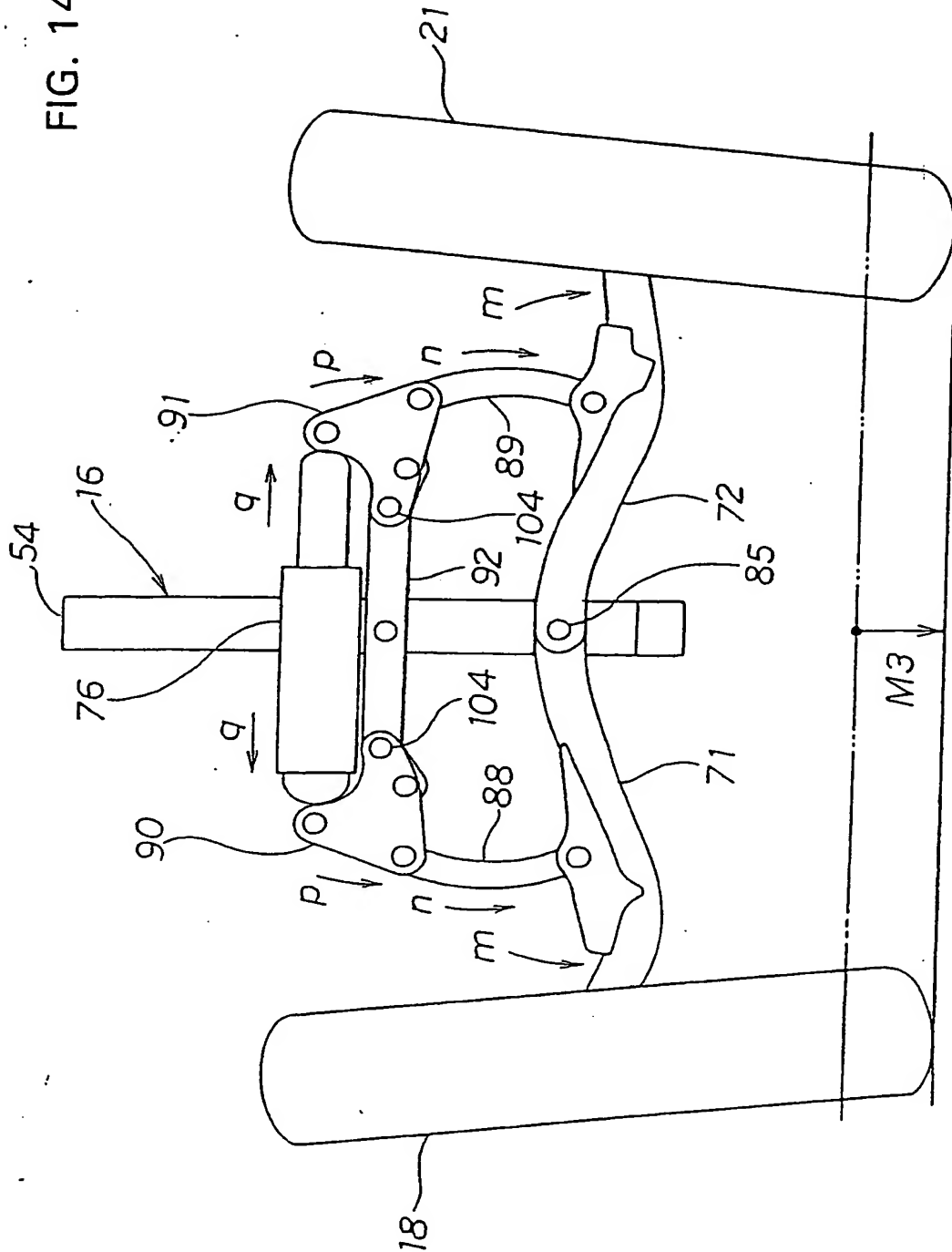
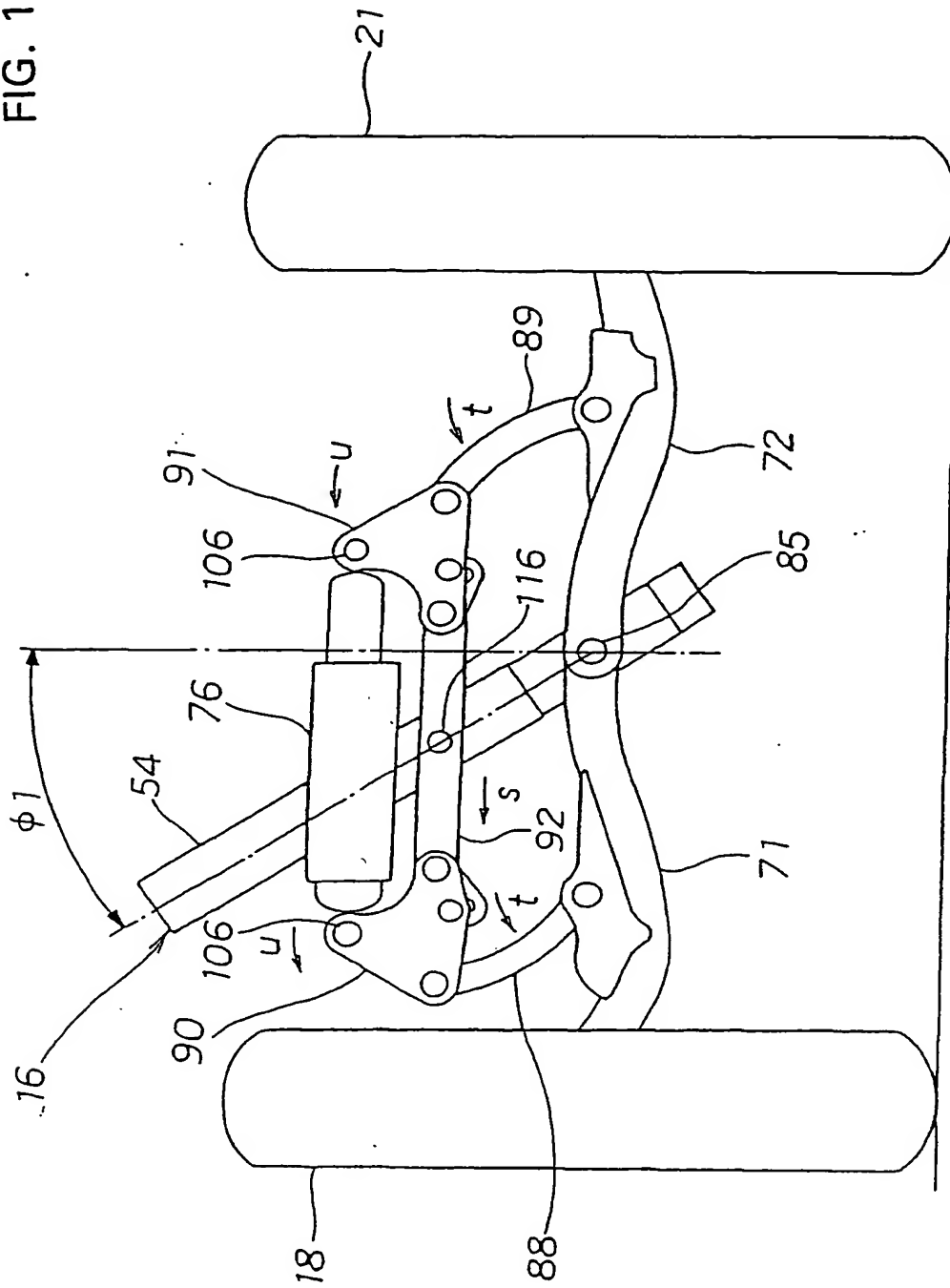


FIG. 15



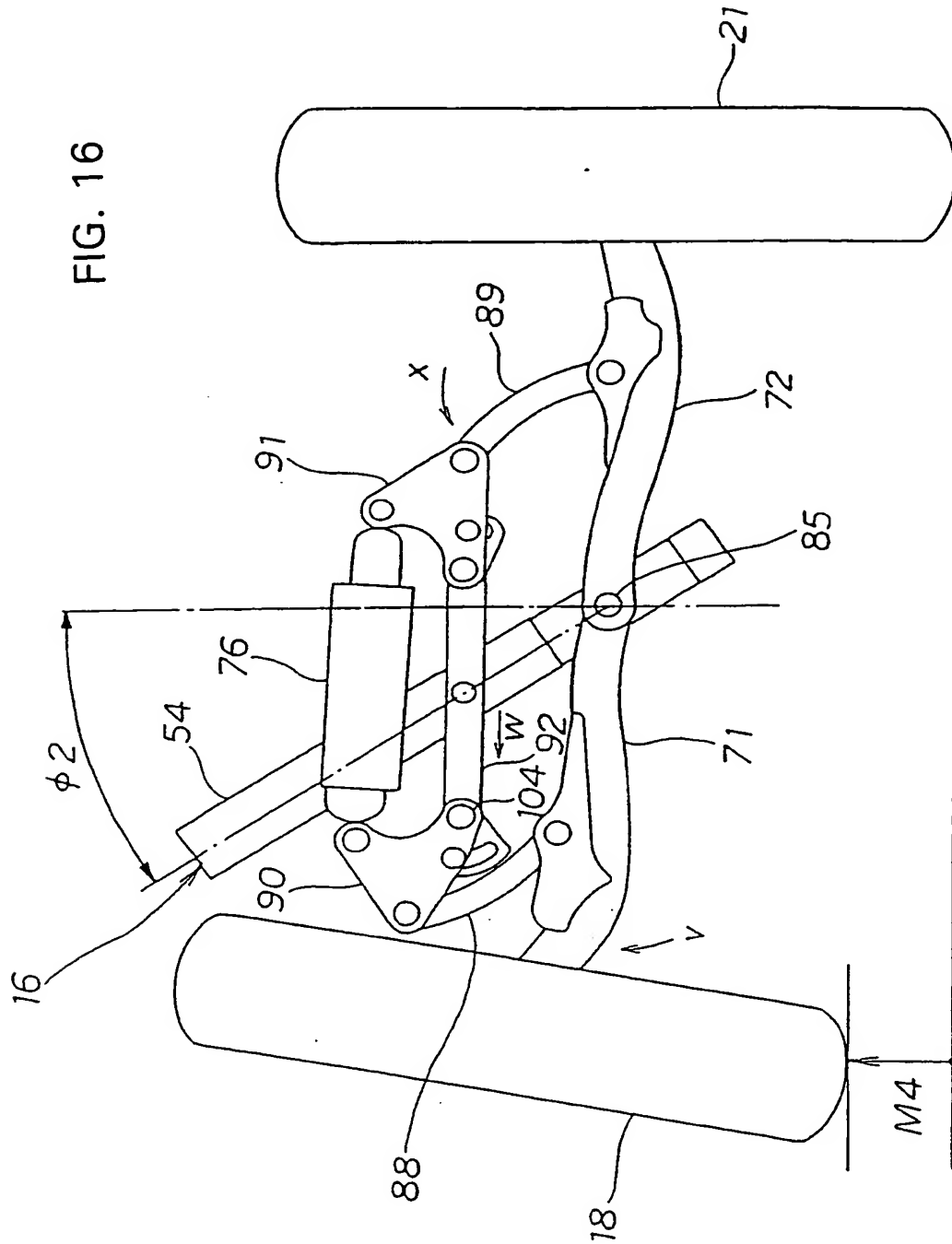
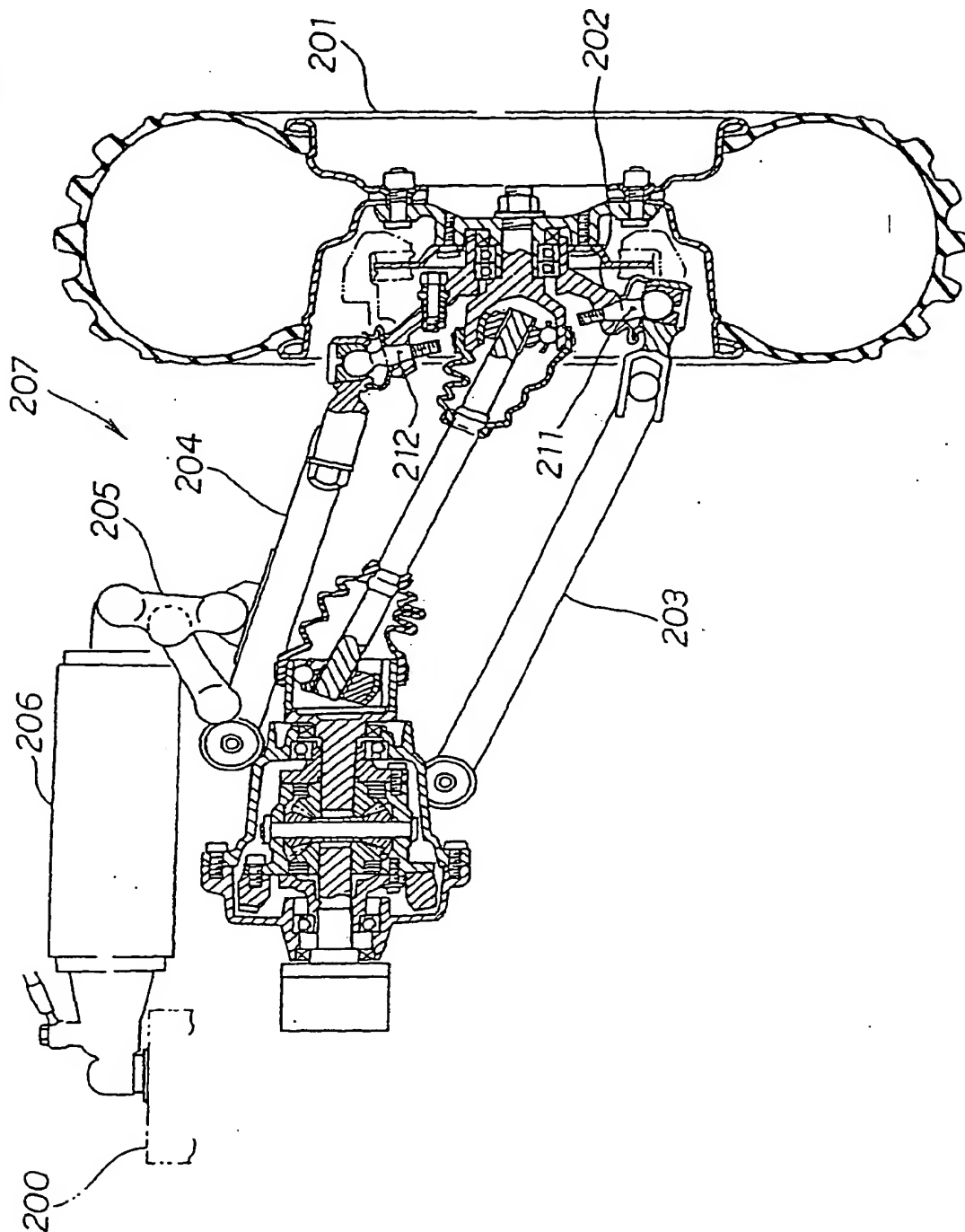


FIG. 17



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## EUROPEAN SEARCH REPORT

Application Number  
EP 03 01 3838

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| Category   | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim  | CLASSIFICATION OF THE APPLICATION (Int.Cl.7) |
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|  |   |  | B62K   |
| The present search report has been drawn up for all claims   |   |  |  |
| Place of search<br>MUNICH  |   | Date of completion of the search<br>16 October 2003  | Examiner<br>Wochinz, R                       |
| CATEGORY OF CITED DOCUMENTS  |   | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or<br>after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding<br>document |  |
| X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another<br>document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |   |  |  |

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16-10-2003

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